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NAVAL WAR COLLEGE
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THE NATIONAL IMAGERY AND MAPPING AGENCY: HARNESSING
GEOGRAPHIC AND IMAGERY INTELLIGENCE IN SUPPORT OF THE
21ST CENTURY JOINT FORCE COMMANDER

by

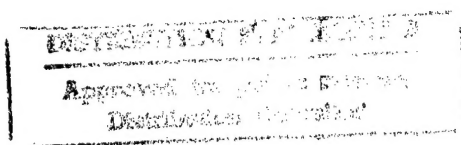
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The contents of this paper reflect my own personal views and are not
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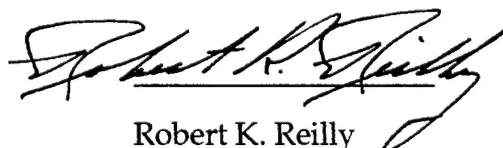
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Abstract of

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The current explosion of information technologies has had a broad impact on the manner in which all of the Service and Intelligence community organizations conduct business. The use of geospatial information and services in the geographic intelligence arena is in its infancy, but growing rapidly. The formation of the National Imagery and Mapping Agency (NIMA) in October 1996, fundamentally changed the means by which the National Command Authority (NCA) and Commander-in-Chiefs (CINC's) exploit national information resources.

Historically, commanders have used hardcopy cartographic products with grease pencil overlays for data fusion and decision making. Today, the ability to disseminate and exploit digital information on the battlefield provide the same commanders with a wealth of geospatial information fusible to other intelligence, enabling them to better plan courses of action and perform battle assessments.

This paper is intended to make the Joint Force Commander aware of NIMA as an important new asset in the quest for total battlespace awareness. NIMA can be an effective force multiplier, or a frustrating operational constraint based on how well the commander understands NIMA's mission, capabilities, strategic vision and structure.

The value of information about the earth is perhaps the only constant in this era of change. With its vision of global geospatial information and services, the National Imagery and Mapping Agency stands ready to support the Joint Force Commander today and into the 21st century.

There is a need now for the Services to implement appropriate doctrine and for the Joint Force Commander to acquire the knowledge necessary to exploit the powerful new intelligence tools NIMA makes available.

CHAPTER I

INTRODUCTION

" [I] spent half of my military career wondering what was on the other side of the hill".

Duke of Wellington¹

The current explosion of information technologies is having a dramatic impact on the way all of the Service communities conduct business. Opportunities now exist for the Joint Force Commander (JFC) to exploit a wide array of information pertinent to overall mission success.

The translation of Geographic Intelligence into usable Mapping, Charting and Geodetic (MC&G) data is an area vital to mission success. The commander must know the geography, hydrography and topography of a region in order to obtain a decisive military advantage. This concept is not new, but the JFC's increasing reliance on advanced cartographic products and services derived from MC&G and geospatial information² is. This reliance is directly related to the growth of "high-tech" weaponry such as Precision Guided Munitions (PGM's) and the global scope of future regional conflicts. The national security threat facing the United States has become increasingly diverse, multi-national and less predictable. In this unstable global environment, commanders require more and better cartographic information at a faster rate than previously available. They also need the information in a format they can understand, use and adapt to their own unique requirements.

Traditionally, the JFC has had to rely on the ability of the former Defense Mapping Agency (DMA), a Combat Support Agency formed in 1972, to produce and deliver current, accurate and relevant MC&G products within the required timeframe. DMA was formed in an era deeply rooted in the containment policy of the Cold War. Consequently, the majority of its resources were dedicated to pre-programmed areas of interest, namely the former Soviet Union. DMA's

organizational structure and production processes were such that the primarily paper products produced were extremely labor intensive, inflexible and completely standardized. Intrusions, such as crisis situations, to the fixed production program were accomplished at a great cost of resources and efficiency. DMA relied heavily on access to imagery collection agencies to obtain the current source for its products. Unfortunately, DMA's priority on the imagery collection "ladder" was often subordinated to other national interests and left the commander's call for support unanswered. DMA's ability to satisfy the JFC's current need for fast, flexible MC&G support was limited at best.

The National Imagery and Mapping Agency (NIMA), is the newest Combat Support Agency of the Department of Defense. NIMA came into existence on 1 October 1996, under the direction of the Defense Authorization Bill for FY97. NIMA is to form "a single combat support agency dedicated to imagery, imagery intelligence, and geospatial information, acting as a focal point for support of all imagery intelligence and geospatial information customers, including customers in the Department of Defense, the Intelligence Community, and related agencies outside the Department of Defense."³ NIMA incorporates the former Defense Mapping Agency (DMA), the Central Imagery Office (CIO), and the Defense Dissemination Program Office (DDPO), in their entirety. The mission and functions of the Central Intelligence Agency's (CIA) National Photographic Interpretation Center (NPIC); and imagery exploitation, dissemination and processing elements of the Defense Intelligence Agency (DIA), National Reconnaissance Office (NRO) and Defense Airborne Reconnaissance Office (DARO), have also been incorporated into NIMA.

The formation of NIMA fundamentally changes the means by which the National Command Authority (NCA) and Commander-in-Chiefs (CINCs) exploit national information resources including imagery, MC&G, and geospatial

information. NIMA is challenged to provide more effective and responsive use of declining national resources to support a national strategy that dramatically expands the requirements for high resolution imagery and high fidelity geospatial information on a global basis to support "global interests and global responsibilities."⁴

This paper is intended to introduce the JFC to NIMA as an important new asset in the quest for total battlespace awareness. NIMA can be an effective force multiplier or a frustrating operational constraint depending upon how well the commander understands NIMA's mission, capabilities, strategic vision and structure. The Services must now implement appropriate doctrine in order to assist the JFC in acquiring the knowledge necessary to exploit the powerful new intelligence tools available from NIMA.

The body of this paper is organized into three major components. The first, lays the foundation for geographic intelligence as it pertains to MC&G data and military operations. The second, explores the value of the National Imagery and Mapping Agency to the JFC and how it will provide critical mission support. The third, outlines the innovative organizational structure of NIMA, specifically designed with the JFC in mind.

CHAPTER II

GEOGRAPHIC INTELLIGENCE AND THE MILITARY: THE UTILITY OF MAPPING, CHARTING AND GEODESY DATA

Cartographically produced products such as topographic maps and hydrographic charts are made up of three primary elements, Mapping, Charting and Geodesy (MC&G) data sets. The operational commander should consider MC&G data as a graphic representation of geographic intelligence. The first two elements, Mapping and Charting, have traditionally referred to a two dimensional hardcopy graphic representation portraying a sector of the earth's surface. A charting product is comprised of information supporting navigation, whereas a map depicts the precise location and types of various surface features. Geodesy data is either the graphic or mathematical depiction of the physical and gravitational components of the earth. Geodesy data establishes an absolute, an accurate foundation or datum that all subsequent maps and charts are constructed from.

Digital information about the earth has emerged as a critical component of modern warfare. A major shift from a focus on two dimensional paper products to one based on digital information and three dimensional views has occurred. Regardless of the composition of the raw MC&G data, the commander's need for aeronautical, topographic and hydrographic products produced utilizing MC&G data remains the same.

The ability of the knowledge of terrain to multiply the effectiveness of a military operation cannot be over emphasized. Carl von Clausewitz, in his book On War, recognized the advantages a commander could gain through knowledge of the land in the following quote:

"... a commander must submit his work to a partner, space, which he can never completely reconnoiter, and which because of the constant movement and change to which he is subject he can never really come to know. . . and the man with enough talent and experience to overcome it will have a real advantage."⁵

Clausewitz realized that the commander must be able to maintain a mental image of the area in order to attain a sense of locality:

"A commander in chief, on the other hand, must aim at acquiring an overall knowledge of the configuration of a province, of an entire country. His mind must hold a vivid picture of the road network, the river-lines and the mountain ranges, without ever losing sight of his immediate surroundings. Of course he can draw general information from the reports of all kinds, from maps, books, and memoirs. . . with a quick and un-erring sense of locality his dispositions will be more rapid and assured; he will run less risk of a certain awkwardness in his concepts, and be less dependent on others."⁶

The premise of geographic intelligence as a force multiplier was recognized by Clausewitz. The scale and nature of the modern theater of operations makes it difficult for today's commander to grasp his sense of "locality". It is for this reason, the potentially large scale and scope of a theater, that the commander's dependence on the exploitation of geographic intelligence into MC&G and Geospatial products has grown exponentially.

CHAPTER III

NIMA AND THE JFC: ANTICIPATING THE 21st CENTURY

"Why do I need NIMA, and how is it going to help me accomplish my mission?" would be a fair question from any commander.

The explosion of information technologies and the increased reliance on fast, accurate, geospatial data by both national and military commanders has provided the impetus to satisfy the "need for speed". The old, fragmented, rigid imagery and mapping communities do not provide the necessary support required by the 21st century Joint Force Commander.

Headquartered in Fairfax, Virginia, the National Imagery and Mapping Agency was established due to the need for a singular resource in the geospatial information and services arena. In recognition of its unique responsibilities and global mission,⁷ NIMA was also designated a part of the U.S. Intelligence Community. The creation of NIMA followed more than a year of study, debate, and planning by the defense intelligence and policy making communities, the U.S. Congress and continuing consultations with customer organizations. With the establishment of NIMA, the imagery and mapping community is now positioned to better serve an expanding customer base, including the JFC. NIMA will accommodate a growing list of imagery and mapping needs through technology and organization and thereby create efficiencies in people, processes, and systems unattainable in the old imagery and mapping communities.

NIMA will benefit all users of imagery, imagery derived intelligence, mapping, and geospatial data by providing them with a common, digital view of the world. NIMA will also provide the bedrock information layers for common, multi-tiered data bases that are accessible electronically, from virtually anywhere on earth.

These layers of imagery and precision geospatial data are the key to effectively using sophisticated weapons and other advanced systems in support of the Joint Force Commander. For example, Operation DESERT STORM provided video tape showing a cruise missile streaking through downtown Baghdad. These missiles were able to navigate over extensive distances at low altitudes, neutralizing specific Iraqi targets with minimal collateral damage. The missiles used a variety of then-DMA produced terrain and target information including Terrain Contour Matching (TERCOM),⁸ Point Positioning Data Bases (PPDB)⁹ and Digital Terrain Elevation Data (DTED)¹⁰. The success of these missiles demonstrated the role that geographic intelligence can play in modern military operations, and an increasing dependence on an agency such as NIMA.

Prior to the establishment of NIMA, a number of organizations had imagery related missions. The fragmented imagery and mapping structures were unable to respond adequately to the commanders evolving and expanding needs. All were struggling to meet customer demand while competing in an era of scarce resources. Potential users such as the JFC, were burdened with several requirements processes, different data standards, tool sets, and imagery products that did not work together. NIMA breaks down these organizational barriers and utilizes all component resources in the creation of a common, digital view of the world.

The national security threat facing the United States has changed dramatically since 1989. The threat is no longer monolithic, or neatly confined within the borders of the former Soviet Union. It is increasingly diverse, multi-national, and less predictable. Those making threats are also less likely to be intimidated by the world's more powerful nations. In a global environment as unstable as this, decision makers require more and better information. They demand that every available scrap of pertinent data be delivered faster, and in a format they can understand, use, and adapt to their own unique requirements. Organizational structures such as that

found in the former DMA, were incapable of adapting to the demands of today's Joint Force Commander.

Change is apparent in the imagery arena as well. Imagery and products derived from it are being called upon to support functions as diverse as the threat possibilities, such as: mapmaking, training, indications and warning, disaster relief, arms control, nonproliferation, mission planning, and precision targeting. Imagery derived products are integral to the success of military operations other than war (MOOTW) : counter-narcotics and counter-terrorism operations, immigration control activities, insurgency and counter-insurgency efforts and operations such as famine relief and peacekeeping. Joint Pub 3-07, Joint Doctrine for Military Operations Other Than War notes the importance of Imagery Intelligence in planning for MOOTW:

“ . . . Remote sensing systems can provide information on terrain, weather and other environmental factors essential to MOOTW. Data from space systems can be used to update antiquated maps and provide up-to-date locations of facilities and obstacles. . . ”¹¹

A recent example spotlighting the scope and utility of imagery exploitation is the former DMA's use of PowersceneTM; a system that combines imagery and geospatial data to produce a computerized, three-dimensional, real time view of terrain. PowersceneTM played a critical role at the highest political levels during the Bosnia Peace Talks in Dayton, Ohio, during November 1995. It assisted policy makers in visualizing the implications of changing boundaries along the strategically important corridor from Sarajevo to Gorazde.

PowersceneTM also had an impact at the National Military Command level as well. Since its installation at the National Military Command Center in the Pentagon in 1994, the terrain visualization system has been used to:

- Study the terrain where Air Force Captain Scott O'Grady's F-16 was downed.
- Support efforts to locate the French Mirage 2000 following its shootdown during operation DELIBERATE FORCE.
- Aid in reconstructing North Korea's shootdown of an Army helicopter along the Demilitarized Zone in December 1994.
- Brief President Clinton on the projected U.S. withdrawal from Somalia.

The demand for imagery intelligence will increase as military commanders and policy makers demand instantaneous access to information about current and emerging "hot spots" anywhere on the globe. This will involve requests for more detailed intelligence in areas of policy interest, and in support of the military's dominant battlespace awareness vision.

Admiral William A. Owens addressed the reliance of the U.S. military on geospatial information in his discussion of "the three core technologies that power the new system of systems: digitization, computer processing and global positioning".¹² He went on to define these three technologies "Digitization permits information to be manipulated, enhanced and compressed for transmission; computer processing speeds this up; and global positioning allows real-time location and targeting of anything tangible."¹³

The ultimate goal of NIMA is to convert today's imagery and mapping production systems into a "client server" system. In this new configuration, imagery and geospatial data will move from collection to distribution in a softcopy, digital format; and in near real time. NIMA will obtain sensor bits from national, military,

and commercial sensors, electronically "push" them into data warehouses, and provide users with the hardware and software tools to "pull" these bits for processing to fit specific needs. In this manner, the user becomes the producer of a custom-built data base containing imagery derived intelligence and geospatial data, to which he may add data tailored to his specific needs and interests. Anyone familiar with the rigid systems of requirements submission, standardized product format and production timelines of the former DMA, can appreciate the revolutionary nature of the new data base available to the JFC. A commander will be able to create products specifically tailored for the mission at hand. This may be accomplished in a real-time mode of operations with the most up-to-date source information possible. This capability will be an invaluable asset both in deliberate and crisis action planning and execution.

Another benefit NIMA will bring to the Joint Force Commander is its built-in power to leverage resources external to the agency. This capability will enable NIMA to take maximum advantage of the growth in the development of commercial imagery and mapping resources. This will add a new dimension to the traditional imagery source baseline. The more source possibilities there are, the greater the chance for an expeditious and accurate end product.

NIMA represents a fundamental step toward achieving dominant battlespace awareness. The achievement of dominant battlespace awareness requires a multi-tiered database, accessible on demand, that networks with theater and tactical databases and fuses information available from all intelligence disciplines. The foundation of this database has to be global, digital imagery and geospatial information. NIMA will provide the resources to build the imagery and geospatial foundation of this common, shared database. Geographic intelligence has entered the interactive era. The JFC would benefit greatly from the time and attention

devoted to this emerging system which has the potential to play a role vital to mission success.

By centralizing responsibility for imagery and mapping, NIMA will be better able than its predecessor organizations to exploit the potential of enhanced collection systems, digital processing technology and the prospective expansion in commercial imagery. NIMA's users will be better able to gain and maintain the information edge in the inevitable conflicts, natural disasters and international crises of the future.

CHAPTER IV

NIMA ORGANIZATIONAL STRUCTURE : THOUGHTFUL DESIGN IN SUPPORT OF THE JFC

Many of the organizations that together now form NIMA previously fielded combinations of liaison officers, technical representatives and special assistants to the Joint Staff, CINC staffs and Service directorates to better refine requirements and provide for a more effective use of resources. This process proved adequate during the Cold War given the nature of the national strategies potential missions and operations plans . Cartographic products, such as maps and charts, were produced well in advance of anticipated operations. The national strategy defined the location of potential battlefields, and through cooperative agreements with allies, high priority requirements could be produced, reviewed and delivered to the commander in the time frame required.

Today, no single geographic based threat to U.S. forces exists. There is however, an increasing requirement to provide the JFC an immediate targeting capability for precision guided weaponry and the ability to conduct offensive information warfare. The Joint Force Commander requires theater-wide coverage of geospatial information in order to secure a sense of battlespace awareness wherever and whenever a "hot spot" flares up.

NIMA has been designed with the Joint Force Commander in mind. The concept is to break the mold of previous organizations. In the past, stovepipe structures lacked an integrated, strategic imagery framework. This resulted in development of unique, stand-alone capabilities, which were not evenly distributed or interoperable. The community lacked a central focus that looked beyond the interests of the immediate user and across budgetary programs.

NIMA will provide the centralized focus required to standardize systems, products and services supporting imagery intelligence and geospatial information throughout DoD and the Intelligence Community. NIMA will ensure that those products and services are integrated seamlessly into the national and defense information infrastructure, in order to avoid "stovepipe" solutions. NIMA is organized in a structure designed to break down the bureaucratic barriers of the past. This will allow maximum communication with the user, and result in the right product, at the right time, the first time.

NIMA has a director with three deputies, (Figure 1). In addition to the three deputy directors, two other elements report directly to the Director of NIMA: the Inspector General and the General Counsel. The three deputy directors align with three directorates: Operations, Systems and Technology, and Corporate Affairs.

- **The Operations Directorate** includes the agency's Customer Support Office which is composed of three business units producing and disseminating agency information; imagery, imagery intelligence and geospatial information. One additional business unit provides common services to production and training for both NIMA personnel and NIMA customers.
- **The Systems and Technology Directorate** includes the senior scientist of NIMA, several research and laboratory sites, acquisition program management, life-cycle system maintenance and standards development/implementation for the imagery, imagery exploitation, and geospatial information communities.

National Imagery and Mapping Agency Organizational Chart

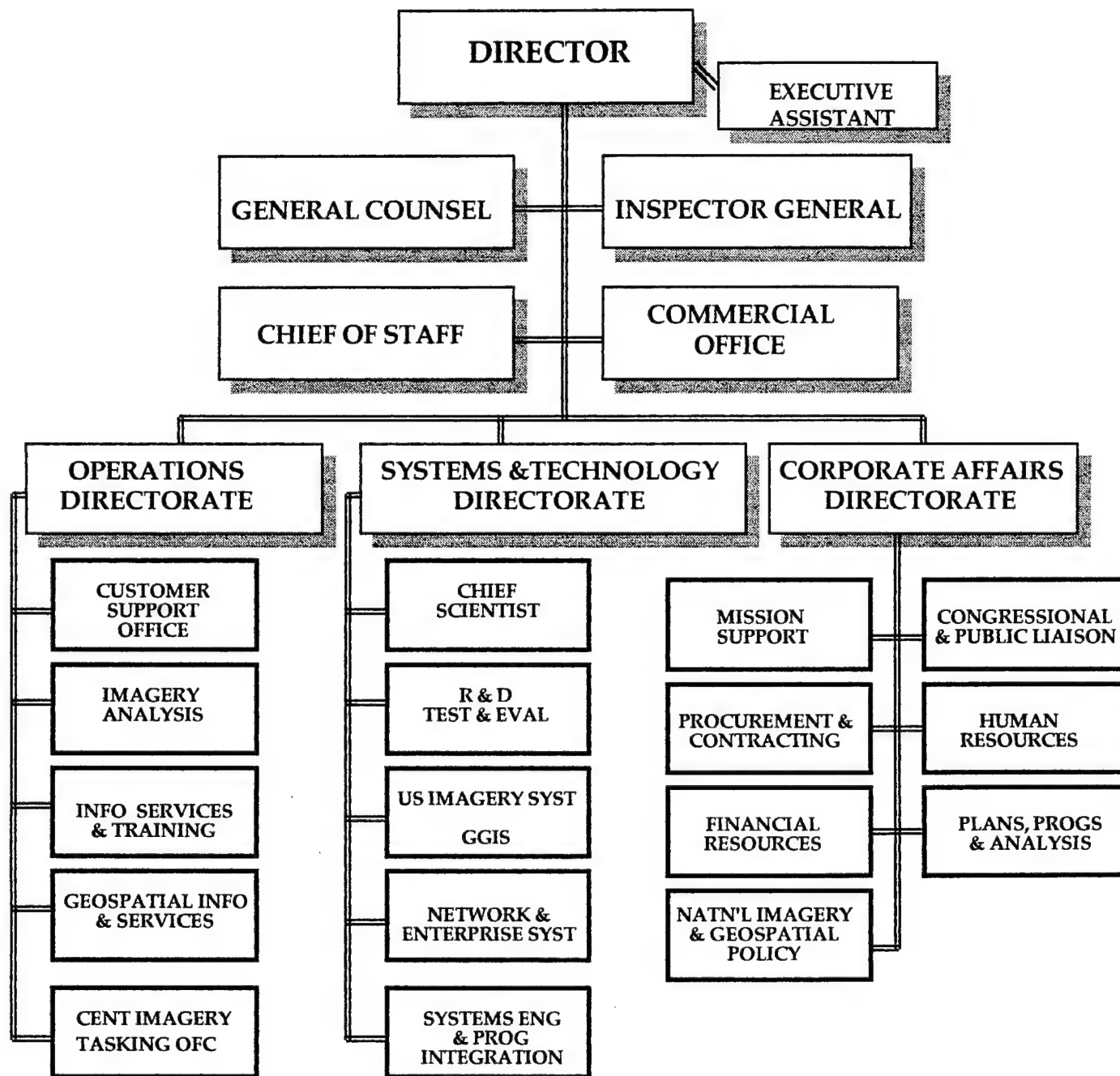


FIGURE 1

- **The Corporate Affairs Directorate** includes several NIMA staff and functional offices: Administration (Facilities, Materiel Management, Logistics, Security), Planning and Analysis, Financial Resources, Human Resources, National Imagery and Geospatial Policy, Contracting, Corporate Information, and Commercial Advocate.

NIMA is further organized around its core, enabling and background processes, allowing the user access to subject matter experts within three layers of management:

- **The core business processes** are those activities and output that define the organization from the viewpoint of its users, such as the JFC. These include Imagery Collection, Dissemination and Management, Imagery Analysis and Geospatial Information and Services. Nearly 5,200 of the 9,000 total NIMA employees are found within the three organizational elements which own these processes. Professionally, most of these employees are cartographers, image analysts, physical scientists, geodesists, computer and telecommunications specialists, and photogrammetrists. Almost all possess at least an undergraduate degree and many have graduate degrees.

- **The enabling processes** are those activities which sustain and technically renew the core process. They include Training and Production Support Services, and Acquisition and Technology. 2,400 NIMA employees, with professional backgrounds comparable to the core processes, are managed within these activities.

- **Background process support** are generally aligned with standard functions such as legal staff, human resources, contracting, comptroller,

facilities, logistics and security. The remaining 1,400 NIMA employees are found within these organizations. These functional activities, with their embedded processes, depend upon skilled individuals with specific functional training and expertise. A large percentage of these individuals are degreed professionals.

The primary entry point for the Joint Force Commander to NIMA, is the Customer Support Team (CST). CST's are established in support of each Unified and Specified Command and for the Service branches (Army, Air Force, Navy, Marines). The CST consists of representatives from the core and enabling business units and can be tailored to the specific needs of the JFC. The primary function of the CST is to work with the JFC to understand what is required to support the mission and to work with the appropriate NIMA business unit to determine how to best provide the product or service. Each CST is geographically located to be of optimum service to the JFC.

This concept represents a very unique mode of operations for a government agency. The entire organizational structure has been designed with the user in mind. For the Joint Force Commander, an unprecedented opportunity to achieve maximum satisfaction and minimum frustration exists.

The design is in place to provide the JFC with superior geospatial information and services. Communication will be key to success however. The CST's are not mind readers, the JFC must ensure open and candid communication to ensure requirements are properly articulated and incorporated into the NIMA production program.

CHAPTER V

CONCLUSION

The value of information about the earth is perhaps the only constant in this era of change. Throughout history, from planning through execution, military operations have demanded a sense of place that can only be gained through maps and reconnaissance. Military activities must have MC&G materials of sufficient accuracy, currency, and content to support operational requirements. With its vision of global geospatial information and services, the National Imagery and Mapping Agency stands ready to serve the JFC today, and into the 21st century.

The fall of communism, and the end of bipolar confrontation between the superpowers in the northern hemisphere, removed some of the issues that were raised by the Cold War but created a new climate of regional instability. Forward deployment of U.S. forces has been reduced dramatically around the world, and the U.S. has adopted a primarily expeditionary role for its armed forces. This type of strategy puts a premium on prior knowledge of potential battlefields and also demands technologies that can support rapid dissemination of information to our forces.

The explosion of information technologies has had a broad impact on the way all of the Service and Intelligence community organizations now conduct business. The use of geospatial information and services in the geographic intelligence arena is in its infancy, but growing rapidly. The formation of NIMA in October 1996, stands as a clear signal that the United States intends to remain the world's leader in information and mapping technologies.

Historically, commanders have used hardcopy cartographic products with grease pencil overlays for data fusion and decision making. With the growth of capabilities to disseminate and exploit digital information on the battlefield, the

same commanders will now have access to a wealth of geospatial information which can be fused with other intelligence in order to plan courses of action and perform battle assessments.

Though many advanced weapon, mission planning, and Command and Control systems have employed digital geospatial information for some time, aspects of interaction with human systems are not well understood. Even as the Department of Defense is proceeding with Battlefield Digitization to enhance situational awareness,¹⁴ few within the defense establishment realize the investment that must be made to develop and populate the framework at a level of fidelity that will support the decision systems currently envisioned. It has been said "Those who rest on their present military advantages, rather than seeking continuous improvements to cope with future threats and the changing conditions of future conflicts, may well be left behind, consigned to defeat in the next era."¹⁵ The challenge to the Joint Force Commander and the Services is the successful implementation of geospatial information as the primary source of geographic intelligence and to utilize NIMA as a force multiplier. This will require that the appropriate doctrine, training and force structures are in place or planned. The challenge for NIMA rises in terms of providing adequate training and insights into these new technologies to ensure successful implementation by analysts for planning and data production. The challenge for NIMA and the JFC lies in the speed in which each adapts to and embraces the geospatial revolution. The "ramp-up" period for NIMA must be minimal while the JFC must "train up" just as fast; the soldiers, sailors, airmen, and marines whose lives may very well depend on the availability of this geospatial information are counting on it.

Above all, open communication, education and close coordination remain paramount; for without each, total battlespace awareness will endure as a vision rather than reality.

NOTES

1. Col. William V. Kennedy et al., Intelligence Warfare, (New York: Crescent Books, 1987), 154-156.
2. Geospatial Information is defined as any information that has associated with it some geographical and temporal reference (includes what is referred to as Mapping, Charting, Geodesy, Imagery, and Intelligence).
3. Defense Authorization Bill for FY 1997, U.S. Congress, House, 104th Congress, 2nd Session, H.R. 3230, Section 1102 (30 July 1996).
4. U.S. Department of Defense, "The Chairman on Modernization", DEFENSE 96, Issue 3, 15.
5. Carl von Clausewitz, On War, (Princeton, NJ: Princeton University Press, 1989), 109-10.
6. Ibid, 110.
7. The official NIMA Mission statement as released by the Director on 1 October 1996, is: "NIMA provides timely, relevant and accurate imagery, imagery intelligence, and geospatial information in support of national security objectives."
8. TERCOM is a digital data set which contains significant terrain and feature attributes utilized by U.S. cruise missiles. The missile's internal navigation sensor matches these data sets to radar images taken in flight and makes course corrections as appropriate.
9. PPDB is one of a family of geopositioning products produced by NIMA which support in-theater targeting activities.
10. DTED is the basic elevation data source produced by NIMA and used by all military activities and systems that require land form, slope, elevation, and/or roughness in a digital format.

¹¹ U.S. Joint Chiefs of Staff. Joint Pub 3-07, Joint Doctrine for Military Operations Other Than War. Washington, D.C.: Department of Defense, 1995.

¹² William A. Owens, ADM, U.S. Navy, "The Emerging System of Systems", U.S. Naval Institute Proceedings, May, 1995, 38.

¹³ Ibid.

¹⁴ U.S. Department of Defense, Annual Report to the President and the Congress, U.S. Government Printing Office, March, 1996, 237.

¹⁵ Barry R. Schneider and Lawrence E. Grinter, *Battlefield of the Future: 21st Century Warfare Issues*, Air War College Studies in National Security, No. 3, September 1995, 273.

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